Reconfigurable antenna for azimuthal beamscanning

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V Basavarajappa[1], V Fusco[1]
[1]The Institute of Electronics, Communications and Information Technology
Queen's University Belfast, Northern Ireland Science Park, Queen's Road, Queen's Island,
Belfast, Northern Ireland, UK. BT3 9DT
Email:v.basavarajappa@qub.ac.uk

A dual band waveguide antenna concept is described which can rotate the antenna farfield pattern in the azimuthal plane in a sectored fashion through 360 degrees at 2.1 and 2.4 GHz. The design is compact and measures 60x60x34mm. Beamscanning to different directions is achieved by exciting sum and difference pattern combinations across the antenna aperture by varying feed phase excitations. The antenna finds application in areas requiring azimuthal dual band beam scanning.

Antenna design

The antenna as shown in Figure 1 is a square evanescent waveguide antenna fed with four printed L- capacitive feed probes with an FSS structure placed across the aperture of the waveguide. This results in a dual band frequency response. The dual frequency band response is obtained by exciting two square rings of different dimensions on different substrates. The outer ring resonates on a 6.15 dielectric and the inner ring resonates over foam, a near unity dielectric. This inhomogeneous dielectric arrangement gives rise to a tilted cosine beam. The different beam orientation and corresponding phase excitation are shown in Table 1.

The antenna was simulated in CST microwave studio and the simulation results obtained are now briefly described.

Simulation results

The port numbering is as shown in Figure 2. The dual band return loss operation of the antenna is shown in Figure 3. The antenna operates between 1.9-2.2 GHz and 2.3-2.5 GHz with linear polarisation. The return loss in both the bands is less than -10 dB and orthogonal port isolation is better than 10 dB across both bands. The return loss behaviour is consistent across both the ports as seen from Figure 3.

The phase excitation for the four ports required to rotate the beam is shown in Table 1. The simulated gain for the radially tilted beam is 2 dBi at 2.1, 2.4 GHz. Azimuthal pattern plots are shown in Figures 4 and 5 for sample rotation angles 0^0 and. 45^0 while the elevation pattern is shown in Figure 6.

Conclusion

A dual band azimuthal scanning antenna with pattern reconfigurability is proposed using a combination of FSS and evanescent waveguide structure. The compactness of this antenna makes it a potential candidate for ATC radar and cellular base station site evaluation.

Acknowledgement

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Azimuthal rotation	Port 1	Port 2	Port 3	Port 4
0 degree [Fig 4]	0	passive	180	passive
45 degree[Fig 5]	0	0	180	180
90 degree[Fig 6]	passive	0	passive	180
135 degree	180	0	0	180
180 degree	180	passive	0	passive

Table 1: Phase excitation at the ports. Passive = port not excited.

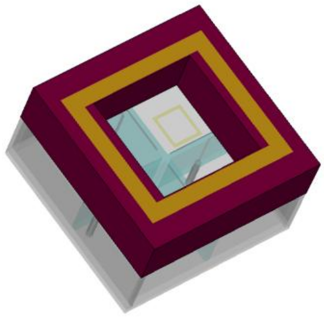

Figure 1: Antenna Topology

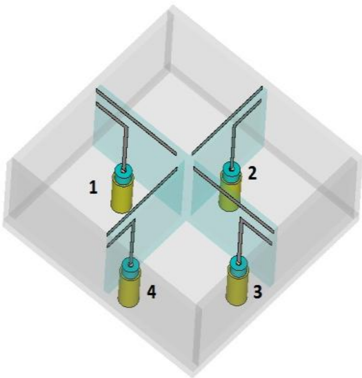

Figure 2: Port numbering

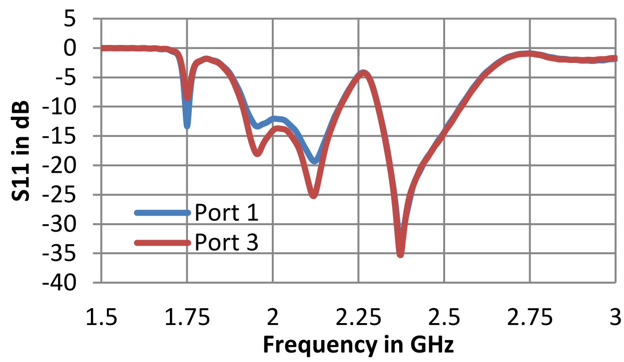

Figure 3: Simulated antenna return loss

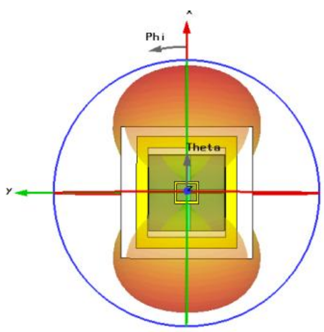

Figure 4: Radiation pattern along azimuth 0 degrees

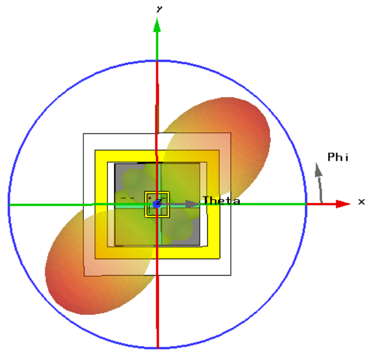

Figure 5: Radiation pattern along azimuth 45 degrees

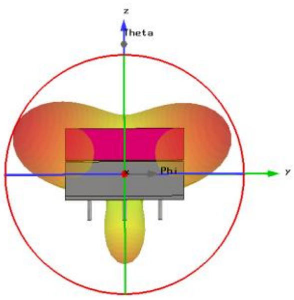

Figure 6: Elevation pattern